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To cite this article: Wietske Rienstra, Tim Blikman, Baukje Dijkstra, Jos van Raay, Geranda Slager, Sjoerd Bulstra, Martin Stevens & Inge van den Akker-Scheek (2019) Validity of the Dutch modified painDETECT questionnaire for patients with hip or knee osteoarthritis, *Disability and Rehabilitation*, 41:8, 941-947, DOI: [10.1080/09638288.2017.1413429](https://doi.org/10.1080/09638288.2017.1413429)

To link to this article: <https://doi.org/10.1080/09638288.2017.1413429>



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Published online: 08 Dec 2017.



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ASSESSMENT PROCEDURE



## Validity of the Dutch modified painDETECT questionnaire for patients with hip or knee osteoarthritis

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### ABSTRACT

**Background:** The modified painDETECT questionnaire (PDQ) is a self-reported questionnaire to discriminate between nociceptive and neuropathic-like pain in patients with knee/hip osteoarthritis (OA). This study aims to assess the structural and construct validity of this questionnaire.

**Methods:** Confirmatory factor analysis and hypothesis-testing was used. For 168 patients, predefined hypotheses were formulated on the correlation between the modified painDETECT and several other questionnaires, and in a subsample of 46 with pain pressure thresholds (PPTs).

**Results:** Two principal components were confirmed. The pain pattern item did not load on any component. Eighty per cent of the hypotheses on the correlation between modified PDQ and the questionnaires were met, as were 50% concerning PPTs measurements.

**Conclusions:** This study is the first to assess structural and construct validity of the modified PDQ knee/hip by using factor analysis and hypothesis-testing. This questionnaire seems to reflect neuropathic-like pain symptoms experienced by hip/knee OA-patients with adequate validity. The item on pain pattern might not reflect the construct. More than 75% of the predefined hypotheses regarding the modified PDQ and the other questionnaires were met. Only 50% of the hypotheses on PPTs measurements were met, probably due to heterogeneity and limited size of this subsample.

### ARTICLE HISTORY

Received 17 May 2017  
Revised 29 November 2017  
Accepted 1 December 2017

### KEYWORDS

Osteoarthritis; knee; hip; painDETECT questionnaire; sensitisation; validity

### ► IMPLICATIONS FOR REHABILITATION



- Pain in osteoarthritis (OA) is partly caused by modification of pain transmission in the peripheral and central nervous system, leading to sensitisation. This process seems particularly significant in a subgroup of OA patients.
- Sensitisation in OA is associated with more disability in daily life, lower quality of life and more widespread pain, as well as poorer outcome of total joint surgery.
- Screening for sensitisation can help to identify the subgroup of patients who could benefit from multidisciplinary treatment options focussing on desensitisation, cognitive- and behavioural therapy and reducing chronification of widespread pain. Therefore, being particularly important in the field of rehabilitation.
- The Dutch modified PainDETECT-questionnaire is very useful for rehabilitation professionals as it is one of the first questionnaires specifically validated to assess neuropathic-like symptoms (indicating sensitisation) in patients with knee or hip osteoarthritis.

## Introduction

Pain is the most disabling symptom of osteoarthritis (OA) and the main reason for patients to seek medical consultation [1]. The aetiology of OA pain is complex and multifactorial, involving both intra- and extra-articular mechanisms [1–4]. A growing number of studies suggest that modification of pain transmission in the peripheral and central nervous system, leading to sensitisation, plays a role in OA pain [4–12]. Sensitisation seems to be associated with neuropathic pain-like symptoms. Sensitisation in OA is associated with more disability in daily life, lower quality of life and more widespread pain, as well as poorer outcome of total joint surgery

[13–18]. Assessment of these symptoms can help to identify patients who could benefit from multidisciplinary treatment options focussing on desensitisation, cognitive- and behavioural therapy and reducing chronification of widespread pain [10].

In hip OA, up to 19% of the patients and in knee OA 19–37% of the patients experience possible or likely neuropathic pain [3,19–23]. Besides clinical assessment by specialised pain physicians and elaborate protocols for physical examination for neuropathic symptoms [quantitative sensory testing, (QST)], several questionnaires are available to distinguish neuropathic pain symptoms from nociceptive pain symptoms. These questionnaires are

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applicable in the ambulatory setting, are easy to use, and do not require specialised examiners. Most of these questionnaires contain similar neuropathic pain descriptors, but because they have been developed in different populations of neuropathic pain patients, some differences exist between them [24–28].

When these questionnaires are applied to specific populations, such as OA patients, validity of the tool needs to be re-evaluated [28,29]. The painDETECT questionnaire (PDQ) is a self-reported questionnaire developed to discriminate between nociceptive and possible or likely neuropathic pain in patients with chronic low back pain [30]. Hochman et al. modified the PDQ to fit knee OA patients [19]. Recently this modified PDQ (mPDQ) was translated into Dutch and adjusted to also fit hip OA patients, resulting in the mPDQ-NL hip and knee [31]. The aim of this study was to assess the validity of the mPDQ-NL in patients with hip or knee OA.

## Methods

Validity was assessed including structural validity and construct validity using elaborate hypothesis testing. For hypothesis-testing, the mPDQ-NL was compared to several other self-reported questionnaires on both similar constructs (convergent validity) and dissimilar constructs (divergent validity). Questionnaires used for this purpose were the Self-reported Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS), subscales of the Knee and Hip disability and Osteoarthritis Outcome Score (KOOS/HOOS), Visual Analogue Scale for pain (VAS pain) and subscales of the RAND-36 health survey (RAND-36).

In OA patients, the most reported somatosensory abnormality from among the QST parameters is a reduced pain pressure threshold (PPT) [7,32]. This could be considered a more objective indication of sensitisation in OA compared to subjective self-report questionnaires so additionally convergent validity was assessed with blunt PPTs. The study was approved by the Medical Ethics Committee of University Medical Center Groningen (number METc2014/087). The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000.

## Participants and procedure

Hip or knee OA patients who were receiving conservative treatment or were on the waiting list for total hip or knee arthroplasty (THA/TKA) were eligible to participate in this study. These patients were recruited from the outpatient clinics of the departments of orthopaedic surgery of three hospitals situated in the northern part of the Netherlands: University Medical Center Groningen, Martini Hospital and Medical Center Leeuwarden. Exclusion criteria were age below 18 years, neurological comorbidities, cognitive or severe psychiatric disorders, and inadequate understanding of written Dutch. A sample of 220 patients was approached and data were collected between April 2014 and February 2015.

Eligible patients received an information letter and a set of questionnaires by mail containing a questionnaire on demographics and comorbidities, mPDQ-NL, S-LANSS, KOOS/HOOS, VAS pain, and RAND-36. Patients were asked to complete the questionnaires and the information letter explained that returning a set of completed questionnaires was considered as informed consent to participate in the study. If patients suffered from OA in more than one joint they were asked to regard the hip or knee which was most symptomatic when filling in the questionnaires. After two weeks, a reminder was sent to non-responders. If questionnaires had missing data, several attempts were done to complete the

items by telephone. A convenience sample of 46 patients was visited at home to perform measurements of PPTs. To constitute this subgroup, patients were selected based on the shortest travelling distance to the participating hospitals. Patients were asked by telephone for consent to visit them and to measure their PPTs.

## Questionnaires and measurements

### Modified PDQ-NL

The mPDQ-NL is a self-administered questionnaire consisting of 12 items on neuropathic pain symptoms in the left or right knee or hip during the past week. The first item concerns the presence of pain radiation using a body map. The second item concerns pain patterns, where patients have to choose between four figures representing distinctly described pain patterns. The following seven items concern pain quality on a 0–5 Likert scale, 0 representing “never” and 5 representing “very strongly”. These items concern *burning sensation, tingling or prickling sensation, pain at light touch, sudden pain attacks, pain at cold or warm stimulus, numbness and pain at light pressure*, respectively. The final three items concern pain intensity on a 0–10 numeric rating scale (NRS), where 0 represents “no pain” and 10 represents “excruciating pain”. These final three items, respectively concern “pain at this moment”, “worst pain in the past week” and “average pain in the past week”. The total score ranges from –1 to 38 points. The final three items on pain intensity are not included in the score. Analogously to the original PDQ, a score of  $\leq 12$  indicates a nociceptive pain profile, a score of 13–18 a possible neuropathic pain profile, and a score  $\geq 19$  a likely neuropathic pain profile [30]. The mPDQ-NL is considered to be a reliable self-report instrument in patients with hip and knee OA, with a good internal consistency (Cronbach’s alpha 0.77 for total score), and good repeatability with a standard error of measurement of 2.6 points and an intraclass correlation coefficient (ICC) of 0.90 [31].

### Self-reported leeds assessment of neuropathic symptoms and signs

The S-LANSS is a self-reported questionnaire to identify pain of predominantly neuropathic origin in patients with chronic pain from any cause [33,34]. The S-LANSS consists of seven items and uses a weighed binary scoring system. The first five items concern neuropathic pain symptoms. The last two items concern clinical signs: patients are asked to gently rub and press the painful area and compare it with a non-painful area. The total score ranges from 0 to 24 points. A score of  $\geq 12$  points suggests pain of predominantly neuropathic origin. In addition, the S-LANSS contains a body map for identifying pain sites and a 0–10 NRS for pain over the last week. These last two items do not contribute to the total score. The S-LANSS has proven to be a valid and reliable self-report instrument for identifying neuropathic pain with a discriminant validity between 73 and 75% compared to expert clinical examination, and a good internal consistency with a Cronbach’s alpha of 0.76. However, it has not been specifically validated for hip or knee OA patients [25,27,28,34]. The Dutch version of the S-LANSS used in the present study was translated and cross-culturally adapted according to international guidelines [35].

### Knee and hip disability and osteoarthritis outcome score

The HOOS, and KOOS are self-administered, disease-specific questionnaires designed to assess patients’ opinion about their knee or hip symptoms and associated problems. Both scores consist of five subscales. For this study the subscales for pain, other symptoms, and activities of daily living (ADL) were used. Answers are

given on a 0–4 Likert scale. For each subscale, a normalised 0–100 score is calculated. These 0–100 scores were transformed so that 0 represents no symptoms and 100 represents extreme symptoms. The HOOS and KOOS are considered reliable and valid instruments in patients with hip and knee OA with good internal consistency for each subscale (Cronbach's alpha above 0.70 each), good test-retest reliability with an ICC between 0.75 and 0.97 for the subscales of the HOOS and an ICC above 0.70 for all subscales of the KOOS, and an adequate construct validity in which 75% of the predefined hypotheses were confirmed for the HOOS and more than 60% for the KOOS [36,37].

#### **VAS pain**

VAS are widely used to measure pain. Patients place a marking on a 100-mm horizontal line that represents their pain. The left ending of the line represents "no pain at all" and the right ending "worst pain imaginable". The distance between the marking and the left ending of the line is measured in whole millimetres and represents the pain score. Patients were asked to record the average pain at rest during the last week in their hip or knee. VAS have been reported as valid and reliable measures for the intensity of pain with a between session reliability of  $r=0.97$ , and a good discriminative validity [38].

#### **RAND-36**

The Dutch RAND-36 Health Survey (RAND-36) is a widely used self-administered, generic health status questionnaire that assesses quality of life and well-being [39]. It contains 36 questions and standardised response choices. These questions are divided into eight different subscales. For this study, the subscales for bodily pain and physical functioning were used. All scores are converted to a 0-to-100 scale, with a higher score indicating higher levels of functioning or well-being. The RAND-36 is considered a highly reliable instrument with good internal consistency for all subscales, in which Cronbach's alphas ranging between 0.71 and 0.91, and satisfactory validity, with convergent validity correlations between 0.42 and 0.80 with corresponding questionnaires [40].

#### **Pressure pain threshold**

Blunt PPT measurements are part of QST. The procedure was based on segments of the QST protocol of the original developers: the German research network on neuropathic Pain [41]. PPTs were measured using a pressure algometer (FDX25 Digital force gauge, Wagner instruments, Greenwich CT) with a 1cm<sup>2</sup> rubber tip. The tip was placed perpendicular to the skin and pressure was exerted with a slowly increasing force of 50 kgf/s (0.5 kg/s). Patients were instructed to indicate the moment the pressure was experienced as an unpleasant feeling and the algometer was removed immediately. The maximum force applied was noted. Before actual measurements were performed patients were familiarised with the procedure. At each site, the average of three measurements was noted. In hip OA patients, PPT was measured 5 cm distally and 2 cm anteriorly of the greater trochanter on the side of the affected hip. In knee OA patients, PPTs were measured at the centre of the patella of the affected knee. In all patients PPT was also obtained from a remote, unaffected location, namely 5 cm proximally of the distal radio-ulnar joint contralaterally of the affected hip or knee. Lowered PPTs at the affected joint area are considered a reflection of peripheral sensitisation whereas lowered PPTs at the remote site are considered a reflection of central sensitisation [32]. All the measurements were performed by a single assessor. PPTs have been used in numerous OA studies in different body regions to assess sensitisation and altered

pain-processing, and have been proven reliable with ICCs ranging between 0.77 and 0.86 [2,14,17,18,23,32,42,43].

#### **Statistical analysis**

Statistical analyses were performed using IBM SPSS Statistics for Windows (version 22.0, Armonk, NY: IBM Corp., NY). Patient characteristics were reported using descriptive statistics consisting of mean and standard deviation for variables with a normal distribution, and median and interquartile ranges for variables with a non-normal distribution (duration of pain, S-LANSS, and PPT).

#### **Structural validity**

Structural validity concerns the degree to which the scores of a measurement instrument are an adequate reflection of the dimensionality of the construct to be measured and can be assessed using (confirmatory) factor analysis [29]. Because the original PDQ was developed for patients with chronic low back pain, it remains to be investigated whether the items of the mPDQ adequately reflect the neuropathic-like symptoms experienced by hip and knee OA patients. Based on the two determinative components described for the original PDQ, confirmatory factor analysis for two principal components was performed according to Kaiser's criterion using varimax rotation [30]. If the loading of individual items on one of the components is  $>0.5$  this loading is considered adequate [29]. If items do not load on any of the components they are considered as not being a good measurement of the construct. Items should load substantially ( $>0.3$ ) on only one of the components and at least three items should contribute to each component [29].

#### **Construct validity**

In order to determine construct validity predefined hypotheses were formed based on similarities and differences between the characteristics and constructs measured by the different measurement instruments. In defining the hypotheses, previous studies were also taken into account. According to the COSMIN criteria, construct validity of a questionnaire is sufficient if 75% of predefined hypotheses are met [29,44]. Pearson or Spearman correlation coefficients were determined depending on normality of the distribution of the different scales. Correlation between mPDQ-NL and S-LANSS was controlled for pain intensity. Correlation coefficients were interpreted according to criteria set by Domholdt et al.: 0.00–0.25 represents little if any correlation; 0.26–0.49 weak correlations; 0.50–0.69 moderate correlations; 0.70–0.89 strong correlations; and 0.90–1.00 very strong correlations [45].

Tables 1 and 2 present the predefined hypotheses based on the following: The constructs of the mPDQ and the S-LANSS are considered the most similar, yet some important differences are present between the two measurement instruments [24,27,28].

Examples of these differences are: (1) binary S-LANSS items versus Likert items in the mPDQ-NL, thereby producing quantitative measurement; (2) a weighed scoring system in the S-LANSS versus equal weighting of the mPDQ-NL items; (3) the S-LANSS contains items regarding autonomic changes which are not characteristic for OA, whereas the mPDQ-NL contains items regarding evoked pain by heat or cold and numbness; (4) the mPDQ-NL is joint-specific whereas the S-LANSS is not. Despite this, Hochman et al. found a strong correlation of 0.73 between the mPDQ and S-LANSS [19].

Correlations of the mPDQ-NL with pain scores of the VAS, KOOS/HOOS and RAND-36 likely reflect the quantitative character



**Table 1.** Predefined hypotheses regarding other self-reported questionnaires.

Instrument compared	Expected correlation	Correlation coefficient	Hypotheses confirmed?
S-LANSS	0.70–0.89	0.59	No
VAS	Higher than VAS	0.51	Yes
KOOS/HOOS	0.50–0.69		Yes
Pain	0.50–0.69	0.64	Yes
ADL	Higher than RAND-36 bodily pain	0.55	Yes
	0.50–0.69		Yes
Other symptoms	Higher than RAND-36 physical functioning	0.46	Yes
	0.26–0.49		Yes
RAND-36			
Bodily pain	0.26–0.49	0.25	No
Physical functioning	0.26–0.49	0.45	Yes
			80%

ADL: Activities of daily living; Sport/Rec: function in sport and recreation; QOL: quality of life; Physic funct: physical functioning; Social funct: social functioning; Role limit physic: role limitations due to physical health problems; Role limit emotional: role limitations due to emotional health problems; VAS concerns the average pain in hip or knee at rest during last week.  $n = 168$ .

of the mPDQ-NL; patients with more intense neuropathic-like pain symptoms are expected to have a higher pain score. Likewise, the ADL score of the KOOS/HOOS and the physical functioning score of the RAND-36 are likely to be influenced by the severity of neuropathic-like pain symptoms. The subscores of the KOOS/HOOS are expected to show a higher correlation with the mPDQ-NL than the RAND-36 subscores, as the latter concern general instead of joint-specific symptoms. The KOOS/HOOS subscore for other symptoms measures a divergent construct (e.g., stiffness, effusion, crepitus), therefore, a weak correlation is expected with the mPDQ-NL. No previous studies are available on the correlation between mPDQ and the VAS pain or subscales of KOOS/HOOS and RAND-36. However, some results are available for the correlation between the PDQ (unmodified), VAS pain and subscales of the RAND-36, reporting correlations between VAS pain and PDQ of 0.39, and of 0.53 in hip and knee OA patients [20,46]. A correlation of 0.30 between PDQ and the RAND-36 pain subscale was previously described [42]. Based on previous studies, a weak correlation of  $\sim 0.30$  was hypothesised between mPDQ-NL knee and hip and the PPTs [42]. As the PPTs are most represented by the specific mPDQ-NL item concerning *pain at light pressure*, the correlation between this item and PPTs was expected to be higher than between PPTs and mPDQ-NL total scores.

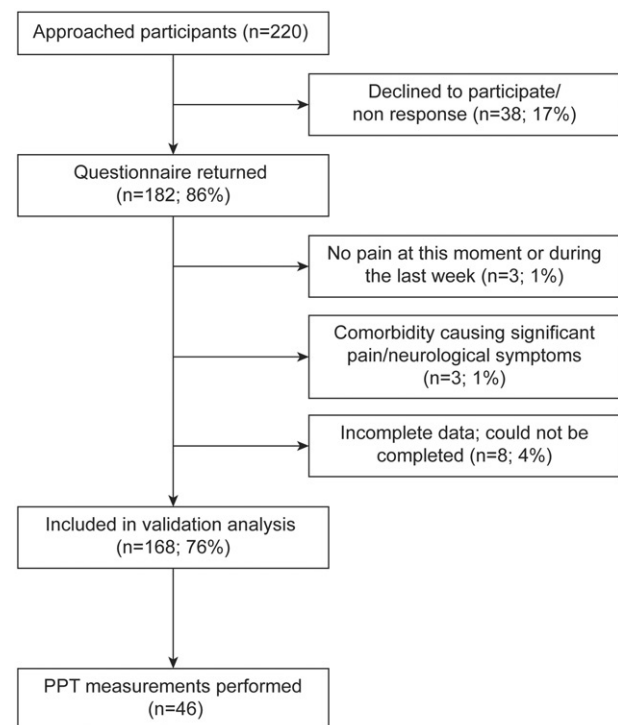
A minimal sample size of 100 participants was pursued as this size is considered excellent for assessing measurement properties of a questionnaire [47]. However, due to logistical challenges a sample size of 50 participants was pursued for construct validation of the mPDQ with PPT measurements.

## Results

A total of 168 patients were included in the study (75 hip and 93 knee OA patients). Figure 1 shows the flow chart for inclusion. PPT measurements were performed in 46 patients, consisting of 16 hip OA patients and 30 knee OA patients. Table 3 presents patient characteristics and descriptive statistics of the collected data.

### Structural validity

Confirmatory factor analysis with two principal components revealed two components with an Eigenvalue  $>1.0$ . The items *pain at light touch*, *light pressure* and *cold or warm stimulus* load adequately on the first component. The items *radiation*, *burning sensations* and *prickling sensations* load adequately on the second component. The items *sudden pain attacks* and *numbness*

**Figure 1.** Flow chart showing inclusion procedure.

substantially load on both factors. The item concerning *pain pattern* does not load on any component. After removing the item concerning *pain pattern* the distribution of the remaining item loadings remained the same and the percentage of explained variance by both components increased from 48.7 to 53.9%.

### Construct validity

Tables 1 and 2 present the correlation coefficients between mPDQ-NL score and the different comparative measurement instruments as well as accordance with the hypotheses. The S-LANSS as well as PPTs in all body regions showed a non-normal distribution, therefore, Spearman's rho correlation coefficients were calculated for these analyses whereas Pearson's correlation coefficients were calculated for the other instruments. In total, 80% of the predefined hypotheses concerning the self-reported questionnaires were met. For PPT measurements, 50% of the predefined hypotheses were met.

Table 2. Predefined Hypotheses regarding PPT measurements.

Instruments compared	Expected correlation	Correlation coefficient	Hypotheses confirmed?
PPT			
Arm	−0.26 to −0.49	−0.04	No
Hip area	−0.26 to −0.49	−0.05	No
Patella	−0.26 to −0.49	−0.09	No
PPT vs mPDQ-NL item <sup>a</sup>			
Arm	Higher than total mPDQ-NL correlation	−0.08	Yes
Hip area	Higher than total mPDQ-NL correlation	−0.35	Yes
Patella	Higher than total mPDQ-NL correlation	−0.10	Yes
			50%

PPT: Pressure pain threshold; mPDQ-NL: Dutch modified painDETECT Questionnaire. <sup>a</sup>PPTs correlated to mPDQ-NL item “pain at light pressure”. *n* = 46.

Table 3. Patient characteristics and descriptive statistics.

	Self-reported questionnaires ( <i>n</i> = 168)	Subgroup PPT sample ( <i>n</i> = 46)
Age (years)	65 ± 10 (37–90)	65 ± 11 (41–90)
Gender		
Female	105 (62.5%)	35 (76.1%)
Male	63 (37.5%)	11 (23.9%)
Body mass index (kg/m <sup>2</sup> )	28 ± 5 (18–45)	29 ± 6 (19–45)
Duration of pain (months) <sup>a</sup>	36 (18–72)	44 (24–96)
mPDQ-NL	12 ± 6 (0–36)	13 ± 5.5 (3–25)
S-LANSS <sup>a</sup>	8 (2–13)	
VAS (mm)	33 ± 21 (0–85)	
KOOS/HOOS		
Pain	54 ± 19 (5–100)	
ADL	59 ± 21 (3–100)	
RAND-36		
Bodily pain	53 ± 19 (0–90)	
Physical function	54 ± 23 (0–100)	
PPT (kgf) <sup>a</sup> ( <i>n</i> = 46)		
Arm		2.0 (1.5–2.0)
Hip area		3.1 (1.6–7.0)
Patella		3.7 (1.5–4.4)
m. tibialis anterior		2.2 (1.8–3.3)

Mean ± SD (min–max) for variables with normal distribution.

<sup>a</sup>Median (IQ range) for variables with non-normal distribution. Gender is shown as number of patients (%).

## Discussion

To our knowledge, this study is the first to assess the structural validity of the mPDQ knee and hip by using factor analysis and to assess construct validity using elaborate hypothesis-testing as proposed by COSMIN guidelines [29,44]. A recent publication by Mathieson et al. describes the poor overall methodological quality of studies examining the measurement properties of neuropathic screening questionnaires – they often lack factor analysis, do not describe the percentage of missing values, and do not define clear hypotheses *a priori* for construct validity [48]. Furthermore, few validation studies have been conducted on screening questionnaires for neuropathic pain symptoms in the knee or hip OA population. The percentage of cases lost to analysis due to missing items was <15%, therefore, selection bias is unlikely and the results can be considered generalisable to the missing part of the population [29]. The results of the present study, therefore, add valuable data to this particular field of research.

Factor analysis confirmed two principal components for the mPDQ. The distribution of items over these components was different when compared to literature on the unmodified PDQ [30,49,50]. The item concerning *pain pattern* did not load on either of the two components, suggesting that this item might not reflect an aspect of the construct of neuropathic pain symptoms in hip or knee OA patients. After removing this item, the percentage of explained variance by both components increased from 48.7 to 53.9%. This is in line with previous data on Rasch

analysis of the unmodified PDQ by Moreton et al. who also found a misfit of the *pain pattern* item in knee OA patients [42]. It might, therefore, be advisable to remove this item from the mPDQ-NL score. A possible explanation is the relatively mixed pain profile experienced by knee and hip OA patients [23]. OA pain typically fluctuates over time and gradually evolves from intermittent weight-bearing to persistent chronic pain [2]. For some patients, this pain is accompanied by neuropathic-like pain symptoms. This is in contrast with studies on the unmodified PDQ in different pain populations, where groups of patients with diagnosed neuropathic pain conditions were compared to patients with typical nociceptive pain conditions [30,49,50]. When interpreting the two components of the mPDQ-NL, the items that only loaded on the first component could be described as “evoked neuropathic sensations”, the items that only loaded on the second component as “spontaneous neuropathic sensations”. There were, however, two Likert items that loaded substantially on both components. For the Japanese unmodified PDQ, two similar principal components were described for the seven Likert items, designated as “spontaneous pain” and “evoked pain” [49]. It is not described how the items were distributed among the two components, therefore, it remains unclear whether the present results are really in line with that study. Moreover, in the original PDQ and the Spanish unmodified PDQ the seven Likert items all loaded on one principal component [50]. It might thus be suggested that two determinative components are present in the mPDQ-NL as well as the unmodified PDQ, but results are inconsistent on this matter.

For construct validity, 80% of the predefined hypotheses concerning other self-reported questionnaires were confirmed in a substantial sample size of 168 patients. The confirmed hypotheses validate the construct measured by the mPDQ-NL. Some hypotheses were not confirmed though. The construct of the S-LANSS was considered one of the most converging, and based on the previous study by Hochman et al. a strong correlation was expected, yet only a moderate correlation was found. A possible explanation is that Hochman et al. did not control for overall pain intensity, contrary to our study [23]. This can be illustrated with the results from the present study when comparing the correlation between mPDQ-NL and S-LANSS (0.59), which was corrected for overall pain intensity, with the correlation between the mPDQ-NL and the pain subscore of the KOOS/HOOS (0.64), which was not corrected.

Correlations between mPDQ-NL and the PPT measurements did not meet our predefined hypotheses; only 50% of the predefined hypotheses were confirmed in a considerably smaller sample size of 46 patients. With regard to the mPDQ-NL item “pain at light pressure”, only the PPTs at the hip joint showed a weak correlation. Because both mPDQ-NL items and PPTs are associated with sensitisation in OA, a weak correlation was expected. This may be due to the relatively small and heterogeneous study

sample in terms of age, BMI and gender. In the literature, these factors are identified to influence PPTs [41,51].

The study sample of the PPT subgroup however was too small to correct for these factors, thereby hampering interpretability of the present results. Assuming that the lack of correlation between mPDQ-NL scores and PPTs found in the present study represents the real relation between these two measurement instruments, these results are an interesting contrast with our predefined hypotheses. However, they support the theory of Wessel et al., who state that PPTs might be measuring different aspects of the pain experience compared to patient-reported assessment of pain experience. A patient's own assessment of pain experience is considered to be influenced by subjective perception, which in turn is influenced by factors other than the direct stimulation of nociceptors. This could mean that direct comparison of subjective patient-reported screening tools for neuropathic pain with more objective measurement tools like PPT and QST in itself may remain an interesting albeit ambivalent field for future studies [52].

Assessment of neuropathic pain-like symptoms by means of the mPDQ can be very useful to help identify the sensitised subgroup of OA patients in order to optimally tailor treatment to the individual patients' needs [10,53]. These patients are more likely to benefit from a multidisciplinary, cognitive, and behaviour-centred treatment program focussing on desensitisation, education, and coping, as compared to somatic-pain centred surgical treatment. Therefore, assessment tools like the mPDQ are especially important to rehabilitation professionals working with OA patients.

## Conclusions

Overall it can be concluded that based on factor analysis and elaborate hypotheses-testing, the mPDQ-NL seems to reflect neuropathic-like pain symptoms experienced by hip and knee OA patients with adequate validity. For construct validity, most of the predefined hypotheses on correlation between the mPDQ-NL and several other measurement instruments were met. Hypotheses on PPT measurements were not met, probably due to heterogeneity and limited sample size of this convenience subgroup. The mPDQ-NL can thus be used to select patients with neuropathic-like symptoms who may benefit from additional treatment options in the multidisciplinary field of rehabilitation to improve their physical and mental well-being. More research is needed into effective interventions for this patient group.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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